

"COILING DEVICE AND METHOD FOR ROLLED OR DRAWN LONG PRODUCTS"

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FIELD OF THE INVENTION

5 The present invention concerns a coiling device and the relative coiling method for long metal products, ferrous or not, as obtained from drawing or rolling operations, whether done hot or cold. To be more exact, the invention concerns the coiling of wire, bars, flat strips, rods  
10 (smooth or ribbed), or tubes, having a transverse section that is round, square, rectangular, hexagonal or otherwise, of various sizes.

To be more exact, the invention concerns the device to guide and contain the coiled product, on the winding  
15 mandrel, in order to contain it laterally and to impose on the forming coil the desired external form. The winding mandrel may have a horizontal, vertical or inclined axis of rotation.

The invention is applied to coiling machines with  
20 cantilevered axis.

BACKGROUND OF THE INVENTION

In the state of the art, the problems connected to coiling, on a continuously rotating mandrel, a long metal product, either rolled or drawn, traveling at high speed,  
25 to be wound in contiguous, adjacent and superimposed spirals, in a uniform manner, so as to form very compact coils, are known.

It is known that the operation to form the coil, so that the spirals are compact and uniformly distributed in every  
30 layer and for the whole longitudinal extension of the coil, is very delicate.

The problem of easily removing the finished coils from the mandrel is also known.

If the operation to remove the coil is not carried out correctly, defects may occur in the finished coils, such as for example the wound spirals may be released and/or the coiled roll may have a bad aesthetic appearance. Moreover, 5 if the coil does not have a regular geometry, there are problems of stacking during the storage step, and also problems with installing the coil on the machine which uses the same, and problems with the correct unwinding of the coiled product.

10 The European patent EP-B-1.126.934 discloses a coiling machine which comprises suitable guides, substantially semi-cylindrical in shape, otherwise known as flaps or insertion blades. Said guides are able to intercept the metal product to be wound, as it arrives from the rolling 15 mill or the drawing machine, and are able to facilitate the formation of the first spirals of the coil on the mandrel. This known coiling machine, which has the axis of the mandrel cantilevered, also comprises a mobile containing plate to frontally contain the coil, which plate cooperates 20 with the terminal, cantilevered part of the mandrel, and which can be arranged in the following two limit positions: a first coil-forming position, wherein the containing plate is orthogonal to the axis of the mandrel and coaxial therewith, and a second position wherein the containing 25 plate is rotated by about 90° and arranged substantially parallel to the axis of the mandrel, in a position of non-interference with the path on which the finished coil is discharged.

Before starting to distribute the spirals on the mandrel, 30 it is necessary that the metal product to be wound is correctly gripped on the mandrel itself; to this purpose, it is necessary to provide a device that performs the attachment of the metal product to the mandrel with great

reliability, precision and repeatability.

The state of the art also comprises the following documents: US-A-2,529,185; US-A-3,105,653; DE-A-3.216.397 and DE-A-3.809.496.

5 One purpose of the present invention is to achieve a coiling device for long metal products which will guarantee a considerable rapidity in installing the mobile frontal containing means that cooperate with the end part of the mandrel.

10 Another purpose of the invention is to guarantee the correct performance of the coiling process.

Another purpose pursued by the device according to the invention is to improve the quality of the final coil in terms of winding, compactness, density and holding capacity  
15 of the spirals.

A further purpose of the invention is to prevent damage and a reduced quality of the product.

It is also a purpose of the invention to simplify maintenance operations on said device.

20 The advantages achieved give a coil having a desired geometric profile which allows to exploit the storage space, also in height, to optimize the handling and transport steps, and gives a better functioning to the user machines, which can thus work at greater speed.

25 Applicant has devised, tested and embodied the present invention to overcome the shortcomings of the state of the art and to obtain these and other purposes and advantages.

#### SUMMARY OF THE INVENTION

The present invention is set forth and characterized in  
30 the main claims, while the dependent claims describe other characteristics of the present invention or variants to the main inventive idea.

In accordance with the above purposes, a coiling device

for long products, whether they be rolled or drawn, according to the present invention is provided with a guide and containing device which has the characteristics as in claim 1.

5     The purposes are achieved also by means of a coiling method for the long metal product which has the characteristics of claim 21.

10     The device and method according to the present invention are applied to machines for coiling long metal products, obtained from rolling or drawing operations, whether performed hot or cold. The products can be irrespectively wire, bars, flat strips, rods (smooth or ribbed), tubes, both of ferrous material such as steels with low, medium or high carbon content, stainless steels, alloyed or other,  
15     and also non-ferrous material, such as aluminum, copper or other. The invention is applied to coiling or reeling machines which have a mandrel with a cantilevered axis.

20     Said long metal products can have any transverse section whatsoever, that is, round, square, rectangular, hexagonal or otherwise, particularly but not restrictively, with diameters between 8 mm and 52 mm or, in the case of bars or flat strips, with a transverse section between 60 mm<sup>2</sup> (for example 20 mm x 3 mm) and 1400 mm<sup>2</sup> (for example 70 mm x 20 mm).

25     In the following description long metal product can be taken to mean any of the above products, and also any similar or comparable products, traveling up to more than 40-45 m/sec with an hourly production of 110 tonnes and more.

30     According to a characteristic feature of the device according to the present invention, the mandrel comprises first arm elements, able to define the cylindrical surface of the core that forms the coil, and second arm elements

able to define a flank of the coil. The first and the second arm elements are mobile between a first coil-forming position and a second coil-removal position.

In one form of embodiment, the first arm elements in their first position are substantially parallel to the central longitudinal axis of the mandrel, while in their second position they are inclined with respect to the central longitudinal axis, so as to define a substantially truncated cone surface converging towards the cantilevered end of the mandrel.

The second arm elements, in their first position, are substantially orthogonal, or very angled, with respect to the central longitudinal axis of the mandrel, while in their second position they are substantially parallel to the central longitudinal axis, and outside the space occupied by the coil formed.

In another form of embodiment, the first arm elements comprise a plurality of axial arms arranged at intervals around the central longitudinal axis, while the second arm elements comprise a plurality of containing arms arranged at intervals around the central longitudinal axis.

#### BRIEF DESCRIPTION OF THE DRAWINGS

These and other characteristics of the present invention will become apparent from the following description of a preferential form of embodiment, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a lateral and partial view of a coiling device according to the present invention, applied to a coiling machine;
- fig. 2 is a three-dimensional view of an enlarged detail of the device in fig. 1;
- fig. 3 shows a first variant of the device in fig. 1.

#### DETAILED DESCRIPTION OF A PREFERENTIAL FORM OF EMBODIMENT

With reference to fig. 1, a coiling device 10 according to the present invention is able to achieve a coil 31 of a long product 36, consisting for example of a metal wire with a circular transverse section.

5 The coiling device 10 comprises a mandrel 11 mounted rotatable and cantilevered, on a fixed cylindrical shaft 32, arranged coaxial with a longitudinal axis X. The rotation of the mandrel 11 with respect to the fixed shaft 32 is achieved in any known manner, for example by means of  
10 a drive member not shown in the drawings. Suitable known guide, positioning and drive means, and all else necessary, not shown in the drawings, are arranged between the mandrel 11 and the relative drive member.

The mandrel 11 comprises a containing flange 12, arranged  
15 perpendicular, or very angled, with respect to the longitudinal axis X. The flange 12 comprises a wall 135 which defines a lateral flank of the coil 31 to be formed. The wall 135 can be fixed, or mobile in an axial direction with respect to the mandrel 11, between a first position to  
20 start the cycle and form the first spirals of the coil 31, and a second position to form the remaining part of the same coil 31.

The flange 12 is associated stably, for example solid, with a central body 30 of the mandrel 11.

25 A plurality of axial arms 13 are pivoted on the central body 30, of which only one is shown in the drawings, arranged angularly off-set and substantially parallel to the axis of rotation X. To be more exact, each axial arm 13 is pivoted to the central body 30 on a pin 15.

30 Each axial arm 13 is able to assume a first position to form the coil 31, to allow the winding of the metal wire 36, and a second removal position, which allows to remove or extract the finished coil 31, removing it axially from

the cantilevered end of the mandrel 11.

In the first position of the axial arms 13, an upper surface 34 thereof, on which the metal wire 36 rests, defines a substantially cylindrical surface of the core that forms the coil 31. In the second removal position, said upper surface 34 of each axial arm 13 defines a truncated cone figure with the smaller diameter facing towards the cantilevered end of the mandrel 11.

Moreover, on the front terminal part of the central body 30 of the mandrel 11, that is, the one in correspondence with the cantilevered end of the latter, at least two containing arms 14 are mounted, of which only one is visible in the drawings, each of which is pivoted on a pin 20.

The containing arms 14 are able to be arranged in a first position, shown in fig. 1, wherein, with a respective wall 35, they define a lateral flank of the coil 31, opposite the one defined by the wall 135 of the flange 12 and, by means of rotation, in a second position wherein they are in a position of non-interference with respect to the axial path on which the coil 31 is removed. To this end, the position of each pin 20 is calculated so that the rotation of the corresponding containing arm 14 does not interfere with the already formed coil 31.

According to one form of embodiment, each containing arm 14 comprises an inclined wall 40 (figs. 1 and 2) which, in the position to form the coil 31, is in contact with a corresponding inclined edge 41 of the axial arm 13, in order to keep the latter in its first position, that is, parallel to the longitudinal axis X. In this way, the containing arms 14 contribute to contrasting the forces which develop in the coil 31 during its formation and which tend to thrust the axial arms 13 towards the longitudinal

axis X.

Moreover, the containing arms 14, in their second removal position, are arranged so as to be contained inside the upper edge of the axial arms 13, when the latter are in  
5 their second position.

The flange 12, according to one embodiment, has a deposition ring 28 which extends axially and which is used to form the first rear spirals 33 of the coil 31.

The containing arms 14, according to one embodiment, have  
10 a lower tooth 27 arranged in cooperation with the wall 35 in order to support at least the inner spirals 33 of the coil 31, and facilitate the inversion of deposition of said spirals 33.

Between the central body 30 of the mandrel 11 and every  
15 axial arm 13, according to one form of embodiment, temporary clamping means are provided which, as shown in fig. 1, comprise a jack 22 whose shaft is inserted in a clamping and positioning bushing 23. Said temporary clamping means 22 intervene only during the steps of  
20 depositing the spirals 33.

The axial arms 13 and the containing arms 14 can be driven from their first to their second position and vice versa by means of shafts, jacks, drive means, levers or other.

25 In one form of embodiment, shown in fig. 1, the aforesaid drive is achieved by means of a rod 17 mounted able to slide inside the fixed central shaft 32. The rod 17 is driven for the desired travel by one or more jacks 21 anchored stably to the drive member, and can include inside  
30 itself channels that conduct cooling fluids, lubricants and/or drive fluids, or even electric cables for sensors, control means or other.

According to one form of embodiment, the rod 17 is



axially holed.

In the form of embodiment shown in fig. 1, the rod 17 is connected to a lever 16 and has rack means 18 in the front terminal part.

5 The lever 16 is also connected to the axial arms 13, so that the axial drive of the rod 17 determines the displacement of the respective axial arms 13 from their first position to their second position.

10 The rack means 18 act on a circumferential toothing 119 made in a lower zone 19 of each containing arm 14, so that the axial displacement of the rod 17 entails the rotation of the containing arms 14 between their first position and their second position.

In order to command the rod 17, instead of the jack means 15 21, drive means can be provided that make the rod 17 rotate, in clockwise or anti-clockwise direction. In this case, (fig. 2), endless screw means 118 are present on the rod 17 which cooperate with corresponding circumferential toothings 119, made both on the levers 16 and also on the 20 zones 19 of the containing arms 14. The endless screw means 118 have a suitable pitch so as to achieve the necessary rotations, even different from each other, of the levers 16 and the containing arms 14. This allows to obtain the same effect as the form of embodiment shown in fig. 1.

25 Fig. 3 shows in detail a containing arm 14, which comprises a support 24 which ends with the zone 19, which is provided centrally with a hole 120 into which the rotation pin 20 is inserted, and a periphery 26 in which the said circumferential toothing 119 is made. The support 30 24 is solid with a front plate 25, which defines the wall 35 and the tooth 27, and which comprises rounded edges in order to prevent interference and impediments.

The containing arms 14 are equal or multiple in number

with respect to the axial arms 13.

The lever 16 (fig. 1), in relation to the axial arms 13, cooperates with cavity-type guide means.

According to the embodiment shown in fig. 2, the mandrel  
5 11 also comprises control means 36 able to control the first position of the axial arms 13; the control means 36 consist for example of screw means which press on the lever 16.

By driving the rod 17 the containing arms 14 are made to  
10 rotate clockwise (fig. 1) around the pin 20, until they are taken to their second position. In this second position the supporting surfaces 40 are dis-associated from the inclined edges 41 of the axial arms 13, thus allowing the latter to move to their second position.

15 It is clear, however, that modifications and/or additions of parts may be made to the coiling device 10 as described heretofore, without departing from the field and scope of the present invention.

It is also clear that, although the present invention has  
20 been described with reference to some specific examples, a person of skill in the art shall certainly be able to achieve many other equivalent forms of coiling device, all of which shall come within the field and scope of the present invention.

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